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(Revised January 22, 1996)

UPPER AQUIFER INVESTIGATION SOW AND SOPS

AMERICAN CHEMICAL SERVICE INC.
NPL SITE
GRIFFITH, INDIANA

PREPARED FOR:
ACS RD/RA EXECUTIVE COMMITTEE

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SCOPE OF WORK
UPPER AQUIFER INVESTIGATION
(Hydraulic Probe Groundwater Sampling)
Revised: January 19, 1996
American Chemical Service Inc.
Griffith, Indiana

SAMPLING METHODOLOGY

The extent of groundwater contamination in the upper aquifer will be delineated in the field using VOCs detected in groundwater samples collected from temporary sampling points (i.e., a hydraulic probe, such as a Hydropunch®). The samples will be field analyzed for a target list of VOCs. VOCs were generally found to be an indicator of groundwater contamination at this site and VOCs are the most mobile constituents. The strong correlation between VOCs and site contaminants was documented in the Remedial Investigation (RI) Report. The target list of VOCs is: benzene, ethylbenzene, toluene, xylene, chlorobenzene, 1,2-dichloroethene, and 1,1-dichloroethane. These were the most frequently detected VOCs in groundwater samples collected from the Upper Aquifer (i.e., greater than four detections out of 24 samples)(see Table 7-2 of the ACS Baseline Risk Assessment Report). Chloroethane was detected greater than four times in the RI but was not included in the field target VOC list because of potential analytical difficulties, and a Performance Standard was not set for chloroethane in the ROD. Chloroethane is one of the four gases on the CLP Target VOC list, and elutes very quickly making it difficult to analyze in the field. #1

The samples will be analyzed in the field with a gas chromatograph (GC) at Level II Data Quality Objectives (DQO). These analyses will allow field judgments to be made for locating the next sampling point or determining that the extent of VOC contamination has been determined sufficiently to locate monitoring wells. The Specific Operating Procedure for the direct analysis of groundwater samples by GC is attached. The total number of samples collected may exceed the originally planned ~~It is anticipated that the samples will be collected at approximately 50 locations, surrounding the site in the~~ The sampling areas shown on Figure 1. The investigation will focus in the four areas, labeled A, B, C, and D on Figure 1. Preliminary sampling locations are marked on Figure 2. The spacing between sample locations is discussed further below. The actual field locations will be subject to field approval by U.S. EPA. The following defines the specific challenges and approach to be taken at each area. #2

AREA A - Wetland Area West of the ACS facility.

Description

Monitoring wells MW-13 and MW-9, located at the edge of the wetland west of the ACS facility, have shown total VOC concentrations in the range of 500 to 1,000 ug/L in groundwater monitoring events. No monitoring wells have been placed in the wetland

further to the west (downgradient), so the edge of the contaminated groundwater has not been defined to the west. On Figure 1, the vertical line demarking the right side of Area A indicates a "line" of known VOC contamination. The challenge is to complete the dotted line on the left side of Area A, which defines the "zero" VOC concentration, as the western edge of the plume.

Sampling Procedure

Three steps are proposed to establish the outer extent of VOC contamination in the wetlands west of the ACS facility. The first step will be to define the outer extent of the VOC plume at one point along a groundwater flow line. The second step will be to collect a groundwater sample at a deeper location to confirm that the edge of the plume identified at the top of the water table also exists deeper in the upper aquifer. The third step will be to collect samples north and south of that point, to establish the "line" that represents the western edge of the groundwater impact in the upper aquifer. The following provide details of each step.

1. Collect samples along the line between piezometer P-26 and M-5 (or beyond M-5) to establish the first "zero" point. Samples will be collected approximately 5 ft. below the surface of the water table. The first sample will be collected in the vicinity of P-26. The location of the second sampling point will be determined in the field, on the basis of the results of the first sample (with Agency concurrence). If the second sample does not indicate the edge of the plume, a third sample will be collected further along the P-26 to M-5 line. The distance again will be a field call, based upon the results of the second sample. This procedure will be followed until the outer extent of the plume is defined at one point in the wetland west of the ACS site.
2. U.S. EPA has expressed concern that there may be downward gradients in the upper aquifer. Therefore, at two points, one near piezometer P-26 and one when the edge of the plume has been defined along the P-26 to M-5 line, an additional sample will be collected from approximately 10 ft. below the water table surface, if the saturated thickness is greater than 10 ft. (If water cannot be collected from a probe to the lower depth, it will indicate that the probe has extended below the upper aquifer, into the clay confining layer, so no sample can be collected). The purpose of the lower sampling level is to determine if VOC contamination exists below the upper five feet in the upper aquifer. If VOC contamination is found, it will indicate that the additional sampling will need to be conducted at that deeper depth, since the shallower sample is non-representative of the edge of the plume. If the deeper sample results are consistent with the shallower result, the sampling will continue at the shallower depth.
3. After the outer extent of the plume has been identified at one point (by step 1 above), the line that delineates the outer extent of the plume will be defined by collecting additional samples north and south of that point. Since groundwater flows perpendicularly to contour lines on a water table map, the "plume front" can be expected to lie generally along a line that is parallel to the contour lines that define the groundwater flow system. The additional sampling points will be field determined (with

Agency concurrence). It is anticipated that the initial locations will be selected at about 100 foot spacing (as allowed by field accessibility).

AREA B - East of Colfax, South of Reder Road.

Description

The upper aquifer contour lines indicate that monitoring well MW-6 is downgradient from the Off-Site Containment Area, and the sampling results at MW-6 indicate elevated levels of VOCs. Monitoring well MW-19 also indicates VOC concentrations in the groundwater. It appears that there may be a plume extending from MW-6 to beyond MW-19. There is no monitoring point that defines the outer extent of the plume on the east side of Colfax Road, although the new piezometers (P-61 and P-62) indicate a potential flow path exists along a line from MW-6 toward MW-19. The primary challenge is to define the outer extent of the VOC plume related to the ACS NPL site to the south and east of Colfax Road, on the south side of Reder Road.

Area B appears to be located in a zone of converging groundwater flow. Groundwater flows beneath Colfax Road from the direction of the ACS facility and the landfill. Groundwater also flows into this area from the residential area north of Reder Road. En route, the groundwater passes beneath several industrial concerns located along the south side of Reder Road. A further objective will be to eliminate the potential that these industrial facilities contribute to the VOC plume detected at MW-19.

A second challenge in Area B is to determine if contamination from an area that contained an underground storage tank (UST) located north of monitoring well MW-6 is contributing to the VOCs detected in MW-6. The City of Griffith Landfill removed the UST and a quantity of contaminated soil early in 1995. Analytical results (Appendix C), indicate that Total Petroleum Hydrocarbon (TPH) concentrations up to 1,500 parts per million may remain in the floor of portions of the excavation.

#3

Sampling Procedure

The general objectives in sampling Area B include: delineating the extent of the groundwater impact south of MW-19, delineating the extent of groundwater impact to the east of P-61 and MW-19, and evaluating the potential effect of the UST.

1. Sampling will be performed at approximately 200 ft. intervals along a line starting approximately 300 feet south of MW-19, running through piezometer P-61, to a point approximately 300 feet north of piezometer P-61.
2. Additional sampling locations will be proposed on the basis of the results of the first line of samples. The general approach will be to utilize a grid-like sampling pattern, consisting of sampling along a second line located approximately 200 feet east of points on the initial line that showed the presence of VOCs. This line will also be sampled at 200 ft. intervals. This procedure of sampling along a line located approximately 200 feet east of areas that showed the presence of VOCs from the previous line will be repeated

until the "zero" point is identified south and east of MW-19, and east of P-61, toward (or beyond) P-62. The sampling spacing will be adjusted in the field as necessary to delineate between the zone of contaminated groundwater and unaffected groundwater. At a minimum, the zone of contaminated groundwater will be encircled by probe samples 200 feet apart.

3. The location of the UST will be identified. One sample will be collected upgradient of the UST (north) and another sample will be collected between the UST and monitoring well MW-6. The suite of VOCs detected in each sample will be evaluated and compared to assess any contribution of VOCs to the groundwater by the UST.

The final objective for Area B will be to complete the "zero line" which is currently shown as a dashed line on the right side of Area B on Figure 1.

Area C - Southwest of Shooting Range.

Description

Sampling on the southwest side of the landfill has indicated that there is not a plume of contamination extending in that direction. However, trace levels of VOCs have been found in MW-15. EPA is concerned that VOCs may be present in the groundwater outside the landfill in the zone between monitoring wells M-1S and MW-15.

Sampling Procedure

Hydraulic probe sampling will occur along the abandoned railroad right-of-way at the approximate locations shown by two x's marked in Area C on Figure 1.

Area D - North and East Perimeter.

Description

A "zero" line was established around the north and east side of the site by Tracer Research sampling in 1990. In fact, the location for monitoring well MW-18 was selected by the Tracer results. The groundwater flow paths can be inferred from the contour lines on the water table map. The contour lines are shown in light gray on Figure 1. The solid line along the east and north side of the site has been drawn to represent a generalized flow path of groundwater. Arrowheads have been placed to indicate the groundwater flow direction. In general, the flow line intersects each contour line at right angles. The location of the line was selected to represent a "zero" line. It goes through MW-18 and MW-11, in which VOCs have not been detected. It goes approximately 200 feet to the east of MW-12, where VOCs totaling 12 ppb have been detected. This is strong evidence for marking the outer extent of Area D as a limit to groundwater flow further outward.

The challenge is to confirm that the line marking the outer extent of Area D is in fact an outer boundary of the area of groundwater containing VOCs.

Sampling Procedure

Sampling in Area D will be approached in a similar grid-like manner as described for Area B. Sampling will begin in the vicinity of SG-6 at the northwest part of the site (where non-

contaminated groundwater has been indicated by the investigation in Area A), and proceed toward the east with approximately 200 foot sample spacing. The sampling will follow the flow line (marked by arrowheads) to the east and then south through Area D, identifying the non-contaminated zone. If a zone of contamination is detected, the next sample will be collected outward from the facility a distance of 50 to 200 feet, depending upon the concentration of the detection. When the zone of non-impacted groundwater is established, the sampling will again proceed to the east, and then south with approximately 200 foot spacing, to define the continuity of non-impacted groundwater in the upper aquifer.

Several samples will be collected ~~across east of Colfax Avenue between the Off-Site Containment Area and the residential area north of Reder Road~~ between MW12 and MW18. If one or more samples in this zone identify a groundwater impact, the next sample will be moved outward to the east away from the ACS facility to establish the outer extent of the impacted groundwater. #4

Surveying

In the week following completion of the field investigation, the horizontal location of each sampling point will be established to 1.0 foot accuracy by a surveyor and the sampling locations will be plotted on a base map.

Quality Assurance/Quality Control for the Field GC

The QA/QC procedures for the field GC are detailed in the attached Specific Operating Procedure. Copies of the instrumentation printouts and graphs will be provided in Technical Memorandum.

Reporting

The results of the Upper Aquifer Investigation will be reported to the U.S. EPA presented in a Technical Memorandum approximately 15 days following completion of the surveying of sampled locations. The memorandum will include a tabulation of sampling coordinates, depths, and concentrations of sampling results. In addition, the detected concentrations will be plotted on the site base map. The Technical Memorandum will also propose monitoring well locations to complete the delineation of impacted groundwater in the upper aquifer. #5

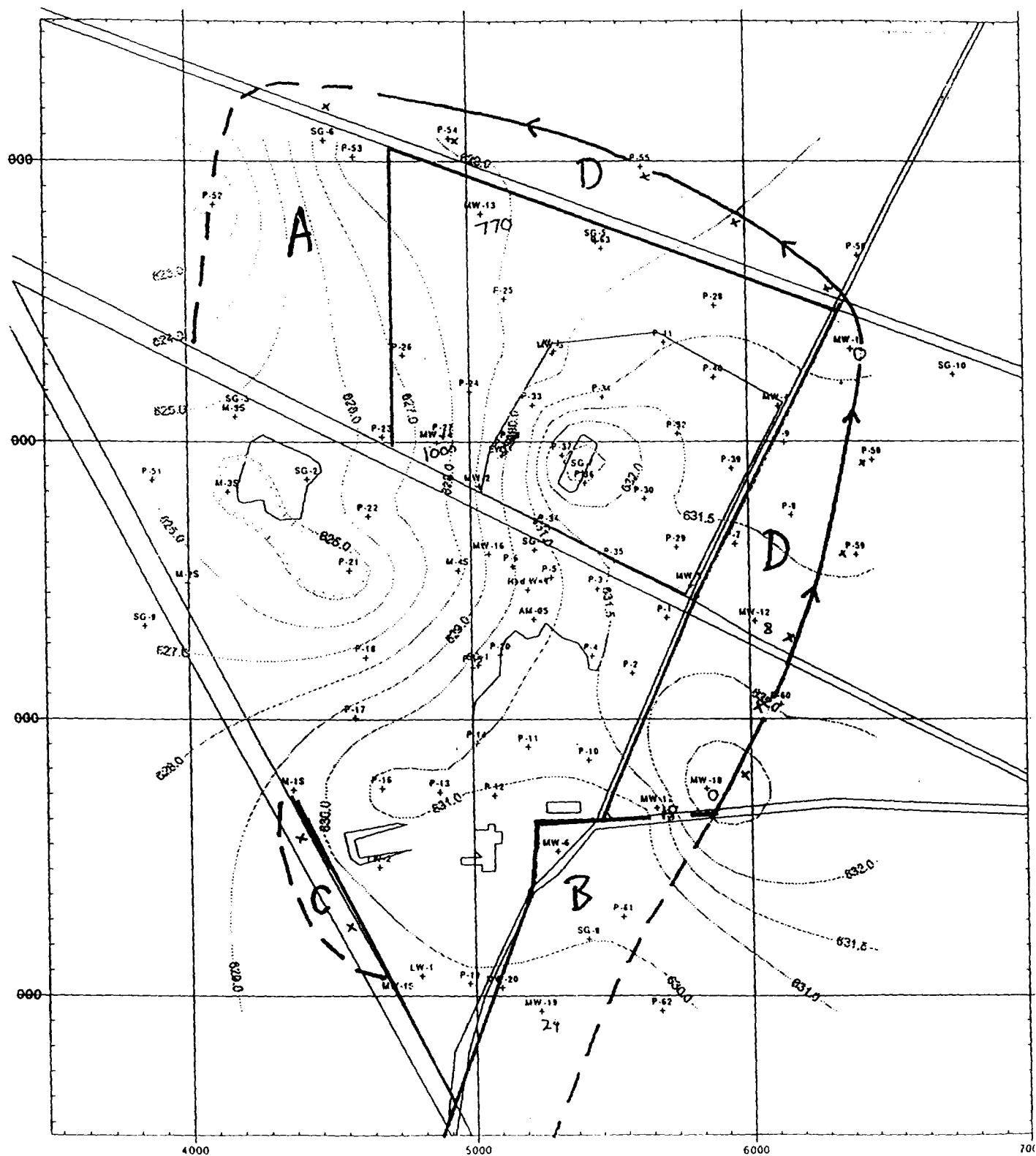
Attachment

Figure 1. ACS NPL Site BaseMap for Hydraulic Probe Groundwater Sampling

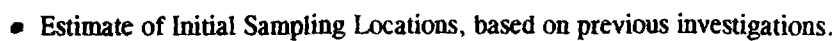
Figure 2. Preliminary Sampling Locations for Upper Aquifer Investigation. #6

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UA-SOW Revised 1/19-96 PJV

Figure 1
ACS NPL Site Base Map for Hydraulic Probe Groundwater Sampling



ACS NPL Site RD/RA



SPECIFIC OPERATING PROCEDURES

UPPER AQUIFER INVESTIGATION

Revised: January 19, 1996

American Chemical Service Inc.

Griffith, Indiana

GROUNDWATER SAMPLING PROTOCOL

Scope and Application: This method is applicable for sampling groundwater in porous media such as sandy soils.

Method: Hydraulically powered direct push sampling units. Sampling unit will be provided by and operated by Fibertec Environmental Services.

I. PRE-FIELD CHECKLIST

- A. Health and Safety Plan with related instruments
- B. Underground Utility Check: 5 to 7 day advance notice required
- C. Off-Site Access agreements completed
- D. Sampling Plan detailing sample types, sample intervals, drilling and sampling methods
- E. Driller contacted and informed
 - 1. Health and Safety Plan
 - 2. Utility check
 - 3. Sampling Plan
 - 4. Decon PAD construction (if necessary)
- F. Field Equipment List
 - 1. Electronic water level tape measure
 - 2. Wooden stakes to mark sampling locations (60)
 - 3. Florescent ribbon for marking sampling locations
 - 4. "Sharpie" or other water resistant marker
 - 5. Field book to record sampling notes.

II. FIELD CHECKLIST

- A. Check for unmarked or uncleared utilities, drive around, walk around
- B. Check for overhead wires
- C. Hydraulic Sampling Unit access
- D. Borehole location correctly staked and labeled
- E. Steam clean well points, rods, hand tools, hydraulic sampling unit
- F. Count number of rods to determine the number used during probing and therefore, the total depth probed
- K. Confirm the correct sampling equipment and borehole abandonment materials are present
- L. Health and safety briefing

III. Hydraulic Probe Sampling of Groundwater and Collection of Groundwater Sample

- A. Hydraulic probe units are mounted on all terrain vehicles. Direct push tooling is advanced by the combination of hydraulic push, percussion (hydraulic hammer), and static force (weight of vehicle).
- B. Advance a 15-mill-slotted well point consisting of a slotted section drive rod 24-in long by 0.76-in I.D. fitted with a solid drive point and a 12-in long drive head to a desired sampling depth, approximately 5 ft. below water table. An additional sample will be collected from approximately 10 ft. below the water table surface in two locations in Area A, by piezometer P-26 and at the "zero" line, if the saturated thickness is greater than 10 ft.
- C. Take a static water level measurement to confirm a five ft. depth and determine the volume of groundwater within the probe rods.
- D. Purge a minimum of three volumes of water by lowering clean ~~reflondisposable~~ polyethylene tubing connected to a peristaltic pump into the probe rods. Purge water will be contained at the probe location in 55-gallon drums and considered to be contaminated until it is tested and found to contain concentrations below values presented in the full list of groundwater contaminants (Table 7 of the Record of Decision) until results of the field analysis are known. If no contamination is detected in sample, the purge water will be discharged to the ground. If VOC contamination is detected above MCLs, ~~t~~ The purge water will be kept in the

#7
#8

drum and moved to the ACS on-site drum storage area as investigative derived material for later sampling and/or disposal.

E. Collect Water Sample:

Careful sampling techniques will be used to obtain a representative sample for analysis of volatile organic compounds (VOCs). As the name suggests, these compounds will volatilize from the water sample upon exposure to air. Therefore, this exposure time will be minimized.

1. Affix an adhesive label to the sample container prior to sample collection. Condensation may form on containers after filling which would make it difficult to adhere labels. Labels should contain sample number (same as probe location: GP xx, starting with GP 50, due to past investigations which ended with GP 48).
2. Remove plastic cap and Teflon coated septum being careful not to contact potential contaminants. If vial and/or cap appears to be defective, discard and use a new vial. The vial should be opened for a minimum amount of time. Two (2) 40-ml. vials must be collected for each sample.
3. Carefully fill vial with continuous flow from the peristaltic pump with aqueous sample until meniscus (mound of water) forms on top. Avoid agitating sample as this may cause a loss volatiles. ~~Should bubbling occur as a result of violent pouring, the sample will be poured out and the vial refilled.~~ Sample contamination may occur if the samples are exposed to a source of VOCs. Do not fill vials near a running motor or any type of exhaust system because discharged fumes and vapors may contaminate the samples. Because samples will be analyzed within 7 days of collection, no 1:1 HCL sample preservation is required. All samples should be kept at 4°C until analysis.
4. Carefully replace (Teflon side down) the cap on meniscus. This will force a small amount of water off the top. Check the vial for air bubbles by inverting vial and tapping the side of the vial gently. Bubbles will rise to the top if present. If bubbles are present, discard the vial and collect a new sample in another vial ~~remove cap and top off vial to create a new meniscus. If bubbles are present after three attempts, discard vial and start with new one.~~ Analysis of samples with air bubbles may not give representative results. #10
5. After successful collection of each groundwater sample, immediately take vials to field laboratory for analysis in a small iced cooler. The field laboratory will maintain an iced cooler for temporary sample storage until sample is ready to be analyzed.

F. Record Sampling Data Number and Location.

In the field book designated for the investigation, record the sample number, the time of collection, ~~the depth below ground surface to the watertable.~~ the depth below ground surface the sample was collected from, and a brief description of the sampling location. For this investigation, the first sampling location will be identified as GP50, and subsequent samples will be numbered sequentially. 19

- G. After sample has been collected and sampling vehicle has moved on, clearly mark the sampling location using a wooden stake, marked with florescent ribbon, and the sample ID number.
- H. Collect Field Blank and Trip Blank:
 - 1. A cooler will be used to shuttle samples from the collection point to the field GC that will be set up at the site office. Two 40 ml vials filled with DI water will be placed in the cooler at the beginning of each day. These will accompany the site samples throughout the day, and be analyzed as the trip blank at the end of the day.
 - 2. A Field Blank will be collected once each day and analyzed in the field GC. The Field Blank will be created by passing DI water through the sampling apparatus and collecting it in two 40 ml vials. It will be analyzed with the trip blank at the end of the day.
- I. Remove sampling equipment from borehole and backfill with bentonite powder or chips, as appropriate. The bentonite should be added slowly to prevent bridging above the bottom of the borehole.
- J. Management of Investigation Derived Waste
 - 1. Purge water will be collected prior to sampling. If sample analysis by field GC indicates that the water contains VOC contamination above MCLs, the water will be containerized and held on site for disposal when site remedy is functioning.
 - 2. Cutting and core samples will not be generated by this method.

SPECIFIC OPERATING PROCEDURES

FIELD GC - PURGEABLE VOLATILES ANALYSIS PROTOCOL

Scope and Application

This method covers the determination of volatile organic compounds in a variety of aqueous matrices in a mobile field laboratory using a gas chromatograph interfaced with a purge & trap. Refer to Table 1 for ACS site specific target compounds and reported detection limits (RDLs). The mobile laboratory will be operated by Montgomery Watson laboratory personnel experienced in fixed and mobile lab operations.

Method Summary

In a mobile laboratory setting, samples are analyzed using a purge & trap interfaced to a GC equipped with a capillary column and photoionization (PID) and electrolytic conductivity detectors (ELCD). This method provides qualitative identification and estimated quantification of VOCs.

Method Reference

"Test Methods for Evaluating Solid Waste", SW-846; July 1992, Methods 5030A and 8021 (modified).

Reporting Limits

Refer to the project compound list (Table 1) for field screening compounds and reporting limits at the ACS site. RDLs may also be affected by high levels of organic compounds, matrix related problems or other interference's.

Optimum Range

Up to 100 times the reporting limit for each matrix group. The optimum range may also be affected by specific compounds, the individual program needs, or project reporting limit requirements.

Reagents and Apparatus (Apparatus can be substituted with equivalents.)

1. Open screw cap 40 mL vial (Pierce #13075 or equivalent).
2. Septum: teflon-faced silicone (Pierce #12722 or equivalent).
3. Purge & trap device: SRI - interfaced to a 8610 GC
4. Trap (primary): Tenax GR (6 x 1/8 in.)
5. Trap (secondary): Carbosieve (6 x 1/8 in.)
6. Purge tubes: 25 mL disposable culture tubes (16x125 mm)
7. Gas chromatograph: SRI 8610 equipped with PID and ELCD detectors in series, megabore capillary column adapters, makeup gas.
8. Column (primary): 15 m x 0.53 mm I.D., MXT-1 metal capillary column, 5 um film depth.

Alternate column: J&W 30 M DB624 or equivalent

9. Glass Syringes: 5 mL Leurlock tip, 1 mL Hamilton, 100 uL Hamilton, 10 uL Hamilton, and 25 uL Hamilton
10. Balance: ± 0.0001 g (Mettler AE200) (for lab use only)
11. Balance: ± 0.1 g (Ohaus LS200)
12. Reagent water - water which has been shown to be organic-free at the method reporting limits
13. Methanol - B&J Brand Purge & Trap Grade
14. Beakers - assorted
15. Volumetric flasks - assorted
16. Pipettes - 5 and 10 mL volumetric
17. Mininert Valves - Leurlock
18. Helium - ultra high purity grade
19. Air- zero grade or breathing grade (for ELCD)
20. Standards (refer to reagent preparation section)

Standards Preparation

1. **Stock Standard Solution:** Stock standards should be prepared prior to going into the field. Prepared stock standard solutions at 5,000 ug/mL may be purchased from a vendor. Alternatively, prepare a VOC standard containing the target compounds at 5000 ug/mL in methanol.
 - Add about 20 mL of methanol to a 25 mL volumetric flask. Allow the flask to stand unstoppered until the methanol on the neck of the flask has dried. Replace the stopper.
 - Tare the flask on the analytical balance.
 - Remove the stopper and, using a 100 uL syringe, add 0.125 g (correct for % purity) of the reference material to the flask. Make sure the drops fall directly into the methanol without contacting the neck of the flask. Replace the stopper.
 - Determine the mass of reference material added. Rinse the syringe with methanol, tare the flask, and add the next reference standard.
 - After the reference materials are added, fill to volume with methanol, cap, and invert to mix.
 - Transfer the final stock standard to a screwtop vial for storage.
2. **Secondary Standard Solutions:** Secondary standards should be prepared weekly and stored at 4°C. Prepare secondary solutions in methanol according to the following scheme:

<u>Standard</u>	<u>mLs</u>	<u>Final Volume</u>	<u>Concentration</u>
5000 ug/mL	1 mL	10 mL	500 ug/mL
500 ug/mL	1 mL	10 mL	50 ug/mL
50 ug/mL	2 mL	10 mL	10 ug/mL

(e.g., add 1 mL of the 5000 ug/mL standard to a 10 mL volumetric flask and fill to the line with methanol and cap. The resulting solution has a concentration of 500 ug/mL.)

3. **Working Calibration Standards:** Prepare calibration standards in DI water according to the following scheme:

<u>Standard</u>	<u>mLs</u>	<u>Final Volume</u>	<u>Concentration</u>
500 ug/mL	20 uL	200 mL	50 ug/L
50 ug/mL	40 uL	200 mL	10 ug/L
50 ug/mL	20 uL	200 mL	5 ug/L

Fill a 200 mL volumetric flask with reagent water to the mark. Directly inject the secondary standard into the water with an appropriate microliter syringe.

Invert the standard 3 times, discard the first 10 mL in the neck of the volumetric flask and transfer aliquots of the standard into a 40 mL VOC vials (no headspace) for storage.

4. **Surrogate Standard:** Surrogate stock standards may be purchased or prepared in advance. The stock standard contains the following two surrogates in methanol:

<u>Compound</u>	<u>Concentration</u>
a,a,a-Trifluorotoluene	2000 ug/mL in Methanol
1,4-Dichlorobutane	2000 ug/mL in Methanol

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Surrogate Working Standard: For the working surrogate solution, add 50 uL of the TFT stock surrogate solution, and 50 uL of the 1,4-DCBA stock surrogate solution to a 10 mL volumetric flask, and dilute to 10 mL with methanol. This is equal to a 10 ug/mL working surrogate solution. Add 5 uL of the surrogate solution (10 ug/mL) to each standard, sample and blank.

Notes

1. This method is intended for use only by an experienced GC operator in a mobile field laboratory.
2. Apparatus can be substituted with equivalents.
3. Gas chromatographic conditions may be changed to optimize the analysis, provided that performance is determined to be equivalent to that of initial demonstration of capabilities.

Procedure

- A. **Gas Chromatographic Conditions:** (Note: SRI rental GCs are configured by SRI for the chosen method prior to shipment. Refer to the SRI manual for specific GC

and purge & trap conditions. Conditions vary depending on column choice. The following are provided as an example.)

Column: 30 m x 0.53 mm I.D., DB624 or equivalent

Carrier Gas: Helium
5 mL/min

Detectors (in series):

1. Photo Ionization - 10.0 eV
Sensitivity - Range 10
Temperature - 230°C
2. Electrolytic Conductivity - SRI dry electrolytic conductivity detector
Mode - Halogen
Reactor temperature - 1100°C

Oven:

Initial - 35°C, Hold for 10 min
Ramp - 4°C/min
Final - 200°C

Purge & Trap System:

Trap: tenax/carboseive 3000
Purge Flow: 40 mL/min
Purge Time: 5 minutes
Dry Time: 3 minutes
Desorb Preheat: 245°C
Desorb: 6 minutes at 250°C
Bake: 4 minutes at 260°C
Transfer line: 100°C

B. Calibration

The instrument must be calibrated daily for all compounds of interest before samples are analyzed. Initial calibration standards must be run at three concentrations, followed by a method blank. The initial calibration must meet the criteria presented in the Quality Control section of this method prior to the analysis of samples. A continuing calibration standard must be run after every ten samples, and at the end of the day. The continuing calibration must meet the criteria presented in the Quality Control section of this method prior to the analysis of samples.

Follow the chart presented above for working calibration standards to prepare standards. Note that concentrations for specific compounds such as xylenes and ketones may vary.

C. Loading Procedure: (All standards, water samples, and the purge water for direct water purging are loaded into purge tubes on the purge & trap in a similar manner.)

#11

1. Fill a 5 mL luerlock syringe with sample or standard. To fill the syringe, remove the plunger from the barrel. Uncap the 40 mL VOC vial, and slowly pour the sample into the barrel, taking care to minimize sample volatilization. Fill the barrel to the top, insert the plunger and adjust the volume. Add 5 uL of the surrogate solution (10 ug/mL) to the sample.
2. Load the sample onto the purge & trap.

If the purge & trap has a sample valve, use the following procedure:

- a) Luerlock the syringe filled with sample to a sample valve on the purge & trap.
- b) Open the sample valve.
- c) Inject the sample into the purge tube with a smooth, steady flow.
- d) Close the sample valve (free end away from line), and remove the syringe.

If the purge & trap does not have a sampling valve, use the following procedure:

- a) the sample must be transferred directly to the purge tube with a slow, smooth steady flow.
- b) Attach the purge tube to the purge & trap and hand-tighten the nut.

D. Analysis of Water Samples:

1. Load calibration standards from low concentration to high onto the instrument as noted in the loading procedure above. Start the GC program to purge the sample and begin the analysis.
2. Prepare a method blank by filling the 5 mL syringe with 5 mL reagent water. Add 5 uL of the surrogate solution (10 ug/mL) to the sample. Load onto the purge & trap and analyze. A method blank must be analyzed daily, or for every batch of 20 or fewer samples of a similar matrix, or whenever potential carryover problems are expected.
3. If all criteria is met for the initial calibration, samples can be loaded onto the instrument and analyzed.

- #12
4. Samples are prepared by filling the 5 mL syringe with 5 mL of sample. Add 5 uL of the surrogate solution (10 ug/mL) to the sample. Load onto the purge & trap and analyze.
 5. After every batch of 10 or fewer samples of a similar matrix and at the beginning and end of the day, a calibration check must be analyzed. Prepare the 10 ug/L check standard as outlined in the "Calibration" (Section B) section of this SOP.
 6. If the sample response for any of the compounds is greater than the response of the highest calibration standard for any analyte, dilution is required. The level of the dilution should be such that the concentration of the analyte(s) is (are) approximately mid-range in the calibration.

Quality Control

1. **Initial Calibration Criteria:**
 - a) A minimum of 3 calibration levels must be included in the curve. One of these levels must be at the RDL.
 - b) The correlation coefficient (r) for the calibration curve must be ≥ 0.995 ($r^2 \geq 0.990$).
 - c) The y-intercept expressed as concentration must be $< \text{RDL}$ for each analyte.
2. **Calibration Check Standard:** After every 10 or fewer samples of each matrix and at the beginning and end of the day, a check standard containing all the compounds in the calibration curve must be analyzed (at 10 ppb). All analytes should fall within $\pm 30\%$ of the concentration for the system to be considered in control. If this criteria is not met, determine whether the compound was detected in any of the bracketed samples. If so, run a standard at the RDL (5 ppb). If the 5 ppb standard is $\geq 50\%$ recovery for that analyte, then no qualification of data is necessary. If the 5 ppb standard is $< 50\%$ then the associated sample data compounds must be qualified. #13
3. **Method Blank:** A method blank must be analyzed at the beginning of every working day before any samples are analyzed and for every batch of 20 or fewer samples of a similar matrix. All compounds of interest must be less than the reporting limit. If any compounds are found in the blank above the reporting limit, corrective action must be taken to alleviate the contamination. Any samples analyzed with the problem blank must have the detected compounds flagged on the final report.
4. **Surrogate Recovery:** Working surrogates are added to each standard, blank, and sample to monitor the performance of the method. Surrogate recoveries are calculated as a percent using the area counts from the sample or blank divided by the area counts from the initial calibration 10 ug/L standard. If a surrogate recovery falls outside of the acceptable control limits of 50 to 150 percent, the sample should be reanalyzed. If the surrogate recovery from the repeat analysis falls outside of the

control limits, flag the data as estimated due to matrix interference. If the surrogate recovery for a blank falls outside acceptable limits, the run must be halted and the problem corrected before additional samples may be run.

5. **Sample Results:** Sample results are not considered complete until bracketed by acceptable standards. Results should also be evaluated for blank contamination and surrogate recovery. Results should not be considered final until peer reviewed. Release of preliminary draft results prior to peer review is strongly discouraged. Users of preliminary draft results should be warned the data is not final and is subject to revision.

Calculations

Water Samples: Prepare a linear regression curve for each compound using a calculator or spreadsheet and the formula:

$$y = xb + a$$

where

y = compound response

x = concentration in ug/L

b = slope

a = y-intercept

Therefore, the sample concentration would be:

$$x = ((y-a)/b) \times \text{dilution factor}$$

Data Reporting

1. All notes, standard conditions, and results will be recorded in a bound notebook.
2. All data generated by field GC will be considered to be tentatively identified, with concentration being estimated.
3. All raw data and the bound notebook will be maintained in the Montgomery Watson project file for final review and archiving.

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GC SOP Revised 1/19/96 JAH

TABLE 1
Expanded BETX Site Target Compound List, Retention Times, & Reporting Limits
Field GC Purgeable Volatiles by Method 8021
For Upper Aquifer Field Screening ("Tracer Investigation")
American Chemical Services
Griffith, Indiana

<u>Compound List</u>	<u>Retention Times</u>		<u>RDL</u>
	<u>MTX-1</u> <u>(min)</u>	<u>DB-624</u> <u>(min)</u>	<u>Waters</u> <u>(ug/L)</u>
trans 1,2 Dichloroethene	11.0	13.7	5
1,1 Dichloroethane	11.3	15.6	5
cis 1,2 Dichloroethene	12.0	17.6	5
Benzene	14.1	20.0	5
Toluene	18.6	24.8	5
Chlorobenzene	20.0	27.9	5
Ethylbenzene	21.1	28.1	5
m,p Xylene	21.3	28.4	5
O-Xylene	21.8	29.2	10

Notes:

This table presents the ACS Expanded BETX Site Target List to be analyzed using the Field GC Purgeable Volatiles SOP (Method 8021). Note that the Work Plan specifies Method 8010/8020; Method 8021 (modified) is a more current VOC method that specifies the use of purge & trap and capillary columns. Both primary and secondary column retention times are included to allow for flexibility in the field. Retention times will vary depending on GC conditions.

TABLE I

Summary of Analytical Results - TPH Gas

Tank Cavity #1
VILLAGE OF GRIFFITH
Town Garage
630 S. Arborgast
Griffith, Indiana

March 31, 1994

SAMPLE NO:	SAMPLE LOCATION	METHOD DETECTION LIMIT	TPH RESULTS
CS-1	NORTH WALL (E)	1.0	BDL
CS-2	NORTH WALL (W)	1.0	1.4
CS-3	SOUTH WALL (E)	1.0	BDL
CS-4	SOUTH WALL (W)	1.0	BDL
CS-5	EAST WALL	1.0	2.6
CS-6	WEST WALL	1.0	BDL
CS-7	EAST FLOOR	500	1,500
CS-8	CENTER FLOOR	1.0	BDL
CS-9	WEST FLOOR	1.0	BDL
CS-10	BACKFILL	20	110

NOTE: Hydrocarbon constituents were measured and are expressed in parts-per-million (ppm) concentrations.

BDL - Below Detectable Limit (< 1 ppm)

BOLD CONCENTRATIONS ARE ABOVE INDIANA DEPARTMENT OF ENVIRONMENTAL MANAGEMENT CLEANUP OBJECTIVES.

All soil samples were analyzed for Total Petroleum Fuel Hydrocarbons (TPH-GAS) per EPA Method 8015.

TABLE II
Summary of Analytical Results - TPH Diesel
Tank Cavity #2
VILLAGE OF GRIFFITH
Town Garage
630 S. Arborgast
Griffith, Indiana

March 31, 1994

SAMPLE NO:	SAMPLE LOCATION	METHOD DETECTION LIMIT	TPH RESULTS
CS-201	NORTH & WEST WALL	10	BDL
CS-202	SOUTH & EAST WALL	10	BDL
CS-203	EAST FLOOR	10	76
CS-204	WEST WALL	10	BDL
CS-205	BACKFILL	50	170
CS-206	PUMP ISLAND	50	65

NOTE: Hydrocarbon constituents were measured and are expressed in parts-per-million (ppm) concentrations.

BDL - Below Detectable Limit (< 1 ppm)

BOLD CONCENTRATIONS ARE ABOVE INDIANA DEPARTMENT OF ENVIRONMENTAL MANAGEMENT CLEANUP OBJECTIVES.

All soil samples were analyzed for Total Petroleum Fuel Hydrocarbons (TPH-ESEL) per EPA Method 8015.

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MANKOFF, INC.